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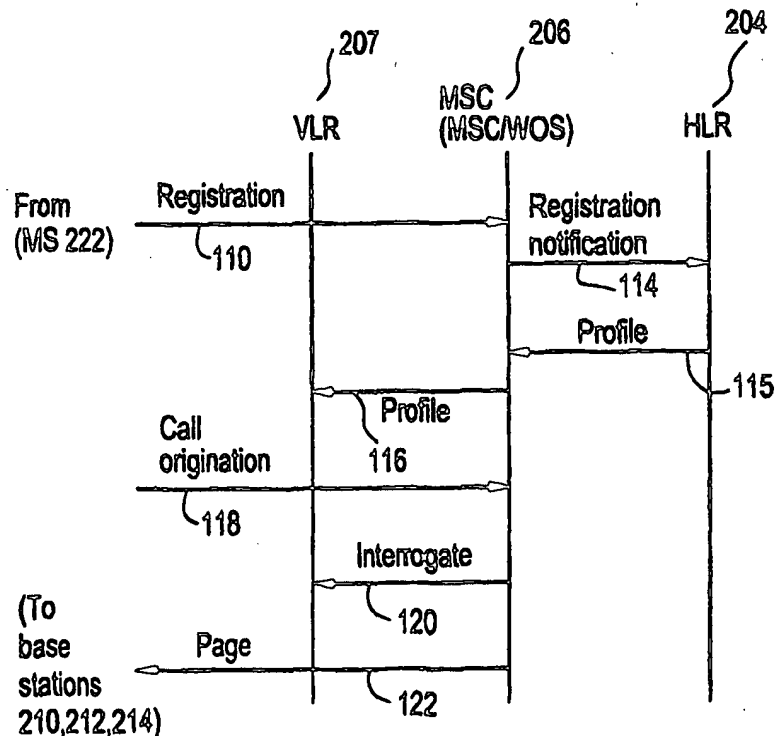
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(54) Title: REDUCING UNNECESSARY COMMUNICATION WITH A HOME LOCATION REGISTER IN A CELLULAR SYSTEM

(57) Abstract

A method for reducing communications with, and signalling to and from, an HLR (204) is disclosed for local or MSC-originated calls (118). When a subscriber registers (114) with the HLR (204), the complete profile for that subscriber is transferred (116) to the VLR (207) associated with the MSC (206) (or MSC/WOS) involved. When a call (118) to the subscriber is originated in the MSC (206), the VLR (207) associated with that MSC (206) is checked (102) to determine if the subscriber's location information is already maintained in the VLR (207). If so, the MSC (206) can page (122) and route the call to the subscriber's mobile phone via (222) the base station transmitter (210, 212, 214) associated with the VLR (207). As such, for such local MSC-originated calls (118), there is no need to interrogate the HLR (204) for subscriber information, thus reducing signalling to and from the HLR (204).



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REDUCING UNNECESSARY COMMUNICATION
WITH A HOME LOCATION REGISTER
IN A CELLULAR SYSTEM

BACKGROUND OF THE INVENTION

Technical Field of the Invention

The present invention relates in general to the mobile telecommunications field and, in particular, to a method and system for reducing unnecessary communication with and signalling to and from a Home Location Register (HLR) in a cellular radiotelephone system.

Description of Related Art

Whenever a call is made to a mobile cellular phone, the directory number (i.e., telephone number) of that mobile phone includes the identity of an HLR in which the mobile phone (and subscriber) is registered. Essentially, an HLR is a network database that contains, among other things, information related to the current location of subscribers' mobile phones independently of the subscribers' actual locations.

For example, as illustrated by the simplified time sequence diagram shown in FIGURE 1, whenever a call 10 to a cellular phone 22 is originated in a Mobile Services Switching Center (MSC) 12, the MSC sends a location request message 14 to the HLR 16 for that phone. Although this procedure can be referred to as an MSC-originated call, the call can actually come into the MSC from a phone (or terminal) in a Public Switched Telephone Network (PSTN), Integrated Services Digital Network (ISDN), Public Data Network (PDN), or another cellular network (e.g., a Public Land Mobile Network or PLMN). Alternatively, the call can be a "local" call that is placed from another mobile phone in the same cellular network. In response to the location request message 14 for the called cellular phone, the HLR 16 can send a routing request message 18 to the appropriate MSC (12) to route the call to a cell where the phone 22 is currently located. As such, the MSC 12 can direct its associated base station transmitters to broadcast a page message 20

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for the phone 22. If the paged phone 22 is powered on and replies to the page message 20, the call can then be set up and directed to that phone 22. Also if required, at call set up, the HLR 16 can also have the MSC 12 execute certain terminating services for the phone's subscriber (e.g., immediate call forwarding, etc.).

In the near future, with the inception of the new, much higher density multi-layered, micro- and pico-celled systems (e.g., in the so-called "Wireless Office Systems" or WOSs, and Fixed Cellular systems), the percentage of "local" cellular-to-cellular (mobile-to-mobile) calls between cells will increase substantially with respect to the total number of calls being handled by the networks. Consequently, a problem with the existing and currently planned WOSs (and Fixed Cellular systems) is that this substantial increase in the number of local calls being made will significantly increase the load on the signalling links to and from the HLR, and also the load on the HLR's and MSC/WOS's (e.g., MSC in a high-density WOS environment) processing resources. Consequently, the call set up times for these local calls (and other calls) will increase significantly. However, as described in detail below, the present invention successfully resolves these and other related problems.

SUMMARY OF THE INVENTION

A method is provided for reducing communication with and signalling to and from an HLR for MSC-originated (e.g., "local") calls so that when a subscriber registers with an HLR, the complete profile for that subscriber is transferred to the VLR associated with the MSC involved. When a call to the subscriber is originated in the MSC, the VLR associated with that MSC is checked to determine if that subscriber's information is already maintained in the VLR database. If so, the MSC can route the call to the subscriber's mobile phone via a base station transmitter associated with that VLR. As such, for such local MSC-originated calls, there is no need to interrogate the HLR for subscriber information, which reduces communications with, and signalling to and from, the HLR.

An important technical advantage of the present invention is that the number

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of accesses required with the HLR is significantly reduced.

Another important technical advantage of the present invention is that unnecessary signalling to and from the HLR can be reduced.

Yet another important technical advantage of the present invention is that the call set up time for mobile-originated and other calls is significantly reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete understanding of the method and apparatus of the present invention may be had by reference to the following detailed description when taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a time sequence diagram that illustrates a simplified signalling sequence for a conventional MSC-originated call;

FIGURE 2 is a time sequence diagram that illustrates a signalling sequence that can be used for MSC-originated and/or local cellular calls, in accordance with the preferred embodiment of the present invention; and

FIGURE 3 is a simplified block diagram that illustrates a cellular system that can be used to implement a preferred embodiment of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

The preferred embodiment of the present invention and its advantages are best understood by referring to FIGURES 1-3 of the drawings, like numerals being used for like and corresponding parts of the various drawings.

Essentially, in accordance with the preferred embodiment of the present invention, for MSC-originated and/or "local" mobile-to-mobile calls, when a subscriber registers with an HLR, the complete profile for that subscriber is transferred to the VLR associated with the MSC (or MSC/WOS) involved. When a call to that subscriber is originated in the MSC (or MSC/WOS), the VLR associated with that MSC is checked to determine if the subscriber's location information is already maintained in that VLR. If so, the MSC can page the subscriber's mobile phone and set up the call via the base station transmitter associated with that VLR. As such, for such local and/or MSC-originated calls, there is no need to interrogate the HLR for

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subscriber information, which reduces communications with and signalling to and from the HLR.

Specifically, FIGURE 2 is a time sequence diagram that illustrates an exemplary method 100 for reducing unnecessary communications with, and signalling to and from, an HLR in a cellular system, in accordance with a preferred embodiment of the present invention. As shown, the exemplary method is described with respect to the Pan-European Global System for Mobile Communications (GSM) 200 as illustrated in FIGURE 3, but the invention is not intended to be so limited and can also be implemented in such cellular systems as the North American Digital-Advanced Mobile Phone System (D-AMPS), Personal Digital Cellular (PDC) System in Japan, AMPS, WOS, Fixed Cellular System, or any other appropriate cellular system that utilizes an HLR or similar functioning network node.

At step 110 of the sequence shown in FIGURE 2, a subscriber's mobile station (MS) 222 initially registers with a network HLR 204 via an MSC (or an MSC/WOS) 206 over a radio air interface as shown in FIGURE 3. At step 114, the MSC (or MSC/WOS) 206 sends a registration notification message to the HLR 204 using a Mobile Application Part (MAP) Signalling System 7 (SS7) protocol (or, for example, using an IS-41 signalling protocol for a D-AMPS). At step 115, the HLR 204 sends a (MAP) message to the MSC (or MSC/WOS) 206 that includes a complete profile for the subscriber and MS 222 involved. The profile includes at least the most current location information for the MS 222 involved. In response, at step 116, the MSC (or MSC/WOS) 206 forwards the subscriber profile to the Visited Location Register (VLR) 207 associated with that MSC. (Notably, in the GSM, an MSC and VLR can be integrated physically, but they can be viewed as two logically separated nodes.) Consequently, the VLR 207 associated with the MSC (or MSC/WOS) 206 that covers the subscriber's MS 222 now maintains in its database that subscriber's profile information. Preferably, this procedure is followed for each MS (and subscriber) that registers with the MSC (or MSC/WOS) 206. A similar procedure is followed for the MSs 224 and 226, and the MSC (or MSC/WOS) 208 that covers their location areas.

At step 118, when a call for the MS 222 is originated in the MSC (or MSC/WOS) 206, the MSC 206 (step 120) interrogates the database in the associated

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VLR 207 to determine whether the called MS's 222 profile information is stored there at that time. If so, at step 122, the MSC (or MSC/WOS) 206 can direct its base station transmitters (210, 212, 214) to broadcast a page message directly for reception by the called MS 222, without having to interrogate the HLR 204 for the MS's location information. In this way, the present invention thus reduces unnecessary communication with, and signalling to and from, the HLR 204, which is especially advantageous for the emerging high density, local mobile-to-mobile call environments, such as, for example, in WOS and Fixed Cellular systems.

As another aspect of the preferred embodiment, in addition to transferring the subscriber profile information to the VLR 207 subsequent to the registration procedure, the subscriber's authentication information (e.g., Shared Secret Data or SSD) can also be transferred to the VLR 207 associated with the MSC (or MSC/WOS) 206 in the same MAP message. In this way, at call set up, there is no need to interrogate the HLR for the authentication information. Alternatively, the VLRs (e.g., 206, 209, etc.) capable of handling local calls can request the subscriber's authentication information from the HLR 204 in a new MAP message.

Additionally, the terminating profile for the subscriber can be added to the profile message in the MAP message sent from the HLR 204 to the VLR(s). Consequently, at call set up, there is no need to interrogate the HLR for the terminating profile information. Alternatively, the VLRs (e.g., 206, 209, etc.) capable of handling local calls can request the HLR for a subscriber's terminating profile information in a new MAP message. As such, if the HLR 204 requires a location request for each subscriber's MS at the set up of a new call, the location information can be included in the subscriber's terminating profile. Alternatively, the HLR can reject the VLR's request for the terminating subscriber profile.

In summary, in accordance with the present invention, by transferring subscriber profile information (including at least the most current location information for the pertinent MS) from the HLR to the VLR associated with the MSC covering the MS at registration, for a local or MSC-originated call to that MS, the MSC can first check with its associated VLR, and if the MS is "registered" with that VLR, then page and route the call directly to the MS without having to interrogate the HLR. Otherwise,

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the call can be set up according to conventional procedures (i.e., interrogating the HLR for location information).

Although a preferred embodiment of the method and apparatus of the present invention has been illustrated in the accompanying Drawings and described in the foregoing Detailed Description, it will be understood that the invention is not limited to the embodiment disclosed, but is capable of numerous rearrangements, modifications and substitutions without departing from the spirit of the invention as set forth and defined by the following claims.

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WHAT IS CLAIMED IS:

1. A method for reducing unnecessary communication with a home location register in a cellular system, comprising the steps of:

responsive to a registration request from a subscriber's mobile station via a mobile services switching center, said home location register transferring a profile for said subscriber to a visited location register associated with said mobile services switching center;

responsive to a local call for said subscriber's mobile station, said mobile services switching center interrogating said visited location register for said profile for said subscriber; and

if said profile is stored in said visited location register, said mobile services switching center directing a page message to said mobile station in order to set up said local call;

otherwise, interrogating said home location register to determine a location for said mobile station.

2. The method of Claim 1, wherein the directing step comprises broadcasting a page message from a plurality of base station transmitters for said phone.

3. The method of Claim 1, further comprising the step of:
responsive to a terminating services profile request message for said subscriber, said home location register transferring a terminating services profile for said subscriber to said visited location register.

4. The method of Claim 1, further comprising the step of:
responsive to an authentication request for said subscriber, said home location register transferring an authentication profile for said subscriber to said visited location register.

5. The method of Claim 1, wherein said terminating services profile

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request message is included in said profile for said subscriber.

6. The method of Claim 1, wherein a request for said terminating services profile message is included in a mobile application part message to the home location register.

7. A system for reducing unnecessary communication with a home location register in a cellular system, comprising:

a mobile station;

a mobile services switching center, said mobile station coupled to said mobile services switching center via an air interface; and

a visited location register coupled to said mobile services switching center, responsive to a registration request from said mobile station, said home location register including means for transferring a profile for said mobile station to said visited location register;

responsive to a local call for said subscriber's mobile station, said mobile services switching center including means for interrogating said visited location register for said profile for said mobile station; and

if said profile for said mobile station is stored in said visited location register, said mobile services switching center including means for directing a page message to said mobile station in order to set up said local call.

8. The system of Claim 7, comprising a GSM.

9. The system of Claim 7, wherein said mobile services switching center comprises a Wireless Office System mobile services switching center.

10. The system of Claim 7, wherein said mobile services switching center comprises a node in a Fixed Cellular system.

11. The system of Claim 7, comprising an AMPS.

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12. The system of Claim 7, comprising a Code Division Multiple Access System.

13. The system of Claim 12, further comprising a Wideband Code Division Multiple Access System.

14. The system of Claim 7, comprising a PDC System.

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FIG.1

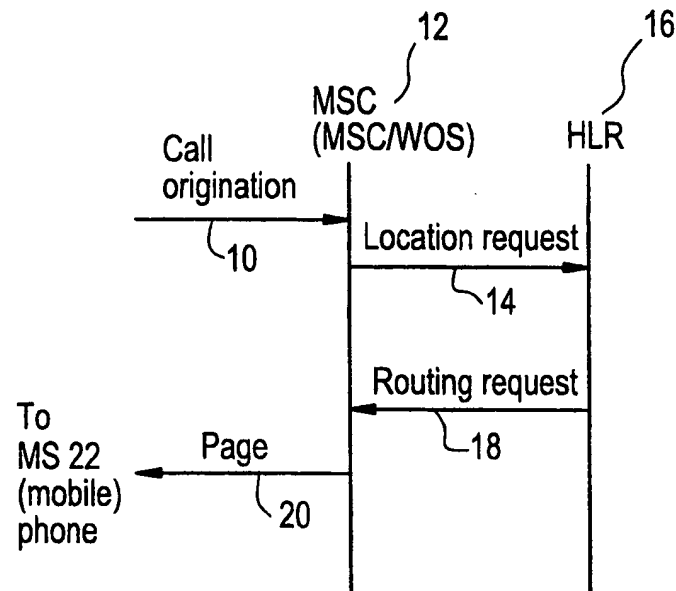
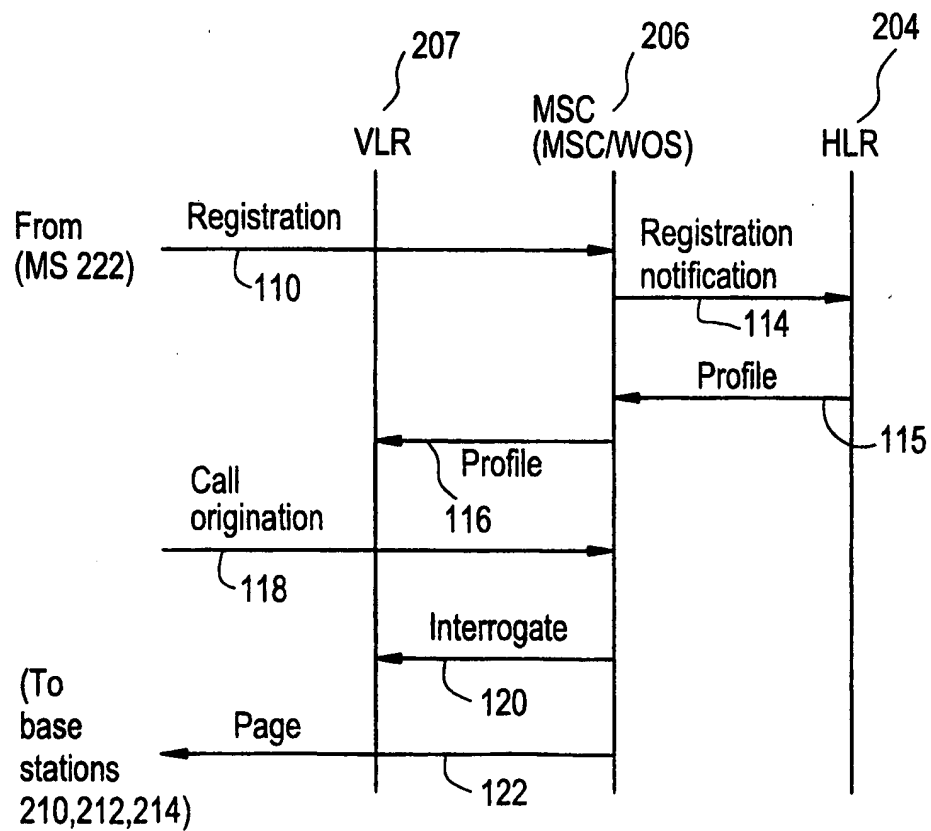
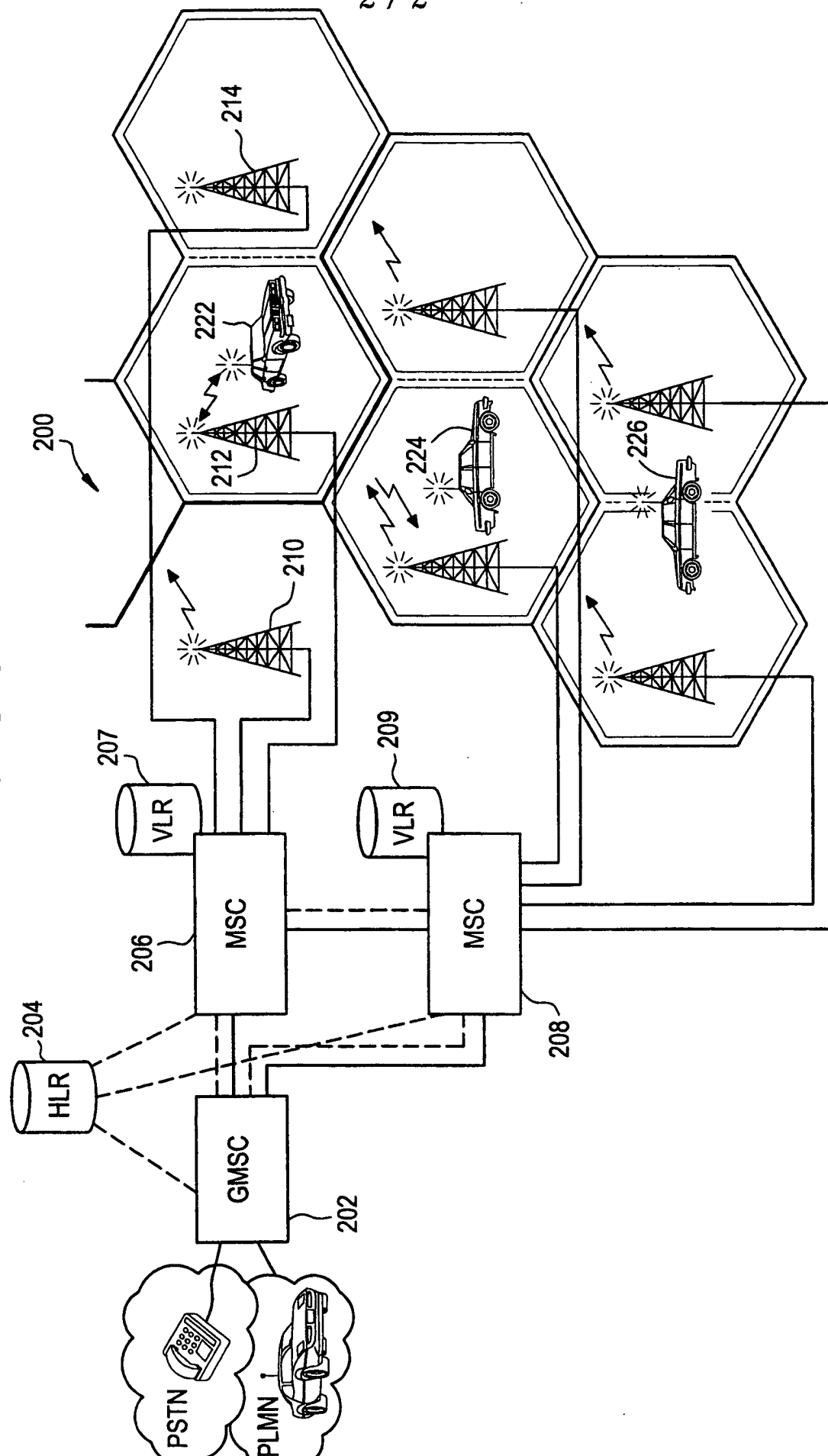


FIG.2



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FIG.3



A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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